Waste Analysis Plans and Their Role in Monitoring Facilities' Compliance with the Land Disposal Restrictions Regulatory Program

(facility names and inspection dates have been redacted for public use)

July 2019

Appendix 1 - Characteristics of a Well-Designed and Well-Operated Treatment System

(Facility 1 and 2 are surrogate names for actual facilities)

Characteristics of a Well-Designed, Well-Operated Stabilization	Facility 1 (BDAT treatment for LDR Phase IV metals)	Facility 2 (TSDF visited for LDR Reinvention FR project)

• Waste segregation
• Size reduction
• Homogenous waste
• Mixing times
• Method of mixing
• Reagents used
• Waste to reagent ratios
• Limits on constituents affecting performance of treatment, e.g., Oil and grease, organics
• Cure time
	• Size reduction (hammer mill and shredding)
	• Use of Portland cement, with addition of water to facilitate reaction
	• Optimal waste to reagent ratio, no impermissible dilution
	• Adequate mixing of waste and reagents to ensure homogeneous distribution; measured introduction of reagents
	  ○ 20-30 minutes to add reagents
	  ○ 45-60 minutes mixing with a backhoe
	• Grab sample taken from each treated batch from backhoe bucket
	• Entire process 36 to 40 hours
		• Typical metals concentration upwards of 5000 ppm and 100-200 mg/L TCLP
		• Use of lime and cement kiln dust
		• Up to three hours of mixing pre-treatment to ensure homogeneity
		• After mixing, waste sampled/analyzed to determine appropriate mix of reagents
		• Waste mixed up to an additional 3 hours
		• Every batch sampled for LDR compliance
		• Facility stated that 1-2 batches out of 30 per month needed retreatment (3.3 - 6.6% failure rate)

Appendix 2- Comparison WAP Sampling, Sampling Frequency Information with Actual Sampling Data

Facility (*names redacted*)	Sampling		Frequency of Testing		Inspection (*dates redacted*)	LDR failure rate	Basis for Failure Rate
	Single grab	Other	Every batch or load tested	Other Type of Testing Frequency			
	X		X			50%	NEIC
	X			First three batches, annual thereafter		33%	NEIC
	X			Periodic		30%	NEIC
		Grab samples to collect representative sample		First batch tested, annually thereafter		25%	NEIC
		Representative Sample	X			25%	NEIC
		Grab sampling Composite samples		--First two batches, and at least once a year thereafter --Post treatment analyses are performed as necessary		20%	NEIC
	X			All batches tested excluding Tier Testing[1]		10.9%	
	X			Tier Testing Tier I – Test batches 1-10 Tier 2 – Test batch 10, batches 11-14 no testing. Test batch 14; batches 16-19 no testing Tier 3 – Test batch 20, batches 21-29 no testing. Test batch 30; batches 31-39 no testing. Test batch 40, batches 41-49 no testing.		10%[2]	Region
	X[3]			--Tier Testing --10-20% of treated batches are tested --Treatment is verified periodically at least annually[4]		2.6%[5]	
		Multiple Grabs (2)	X			0%	NEIC
						84%	NEIC
		Grab sample or grab samples		First three loads for each profile, quarterly thereafter		0%	NEIC
		Repetitive sampling (composite)	X			0%	NEIC
	X	Random grab	X			0%	NEIC

[1] In CY 2013, tested 640 of 762 batches, with a LDR failure (re-treatment rate) of 10.9%.
[2] During the inspection 10 put piles were sampled. 1 sample from each of five put piles was taken and 2 samples from the other five were taken for a total of 15 samples. Two samples from one pile both failed for Lead.
[3] Using a grab sample was information provided by ___ in the OECA questionnaire, it was not conveyed in their WAP.
[4] This information was obtained from the WAP.
[5] In CY 2013, ___ tested 808 of the 3064 batches of hazardous waste treated, 2,256 no testing directly landfilled.

Appendix 3: Comparison of WAP's Well-Designed, Well-Operated System Elements, Sampling Frequency and Actual Sampling Data

Facility (*names redacted*)	Well-Designed, Well-Operated System		Frequency of Testing		Inspection (*dates redacted*)	LDR failure rate	Basis for Failure Rate
	Reagents Identified	Mixing Method, Mixing Time or Homogenous mixture	Every batch or load tested	Other Type of Testing Frequency			
	X	X	X			50%	NEIC
	X			First three batches, annual thereafter		33%	NEIC
	X[6]	X[7]		Periodic		30%	NEIC
				First batch tested, annually thereafter		25%	NEIC
	X[8]		X			25%	NEIC
	X	X[9]		--First two batches, and at least once a year thereafter --Post treatment analyses are performed as necessary		20%	NEIC
		X[10]		All batches tested excluding Tier Testing[11]		10.9%	
				Tier Testing Tier I – Test batches 1-10 Tier 2 – Test batch 10, batches 11-14 no testing. Test batch 14; batches 16-19 no testing Tier 3 – Test batch 20, batches 21-29 no testing. Test batch 30; batches 31-39 no testing. Test batch 40, batches 41-49 no testing.		10%[12]	Region
	X			--Tier Testing --10-20% of treated batches are tested --Treatment is verified periodically at least annually[13]		2.6%[14]	
			X			0%	NEIC
						84%	NEIC
				First three loads for each profile, quarterly thereafter		0%	NEIC
			X			0%	NEIC
			X			0%	NEIC

[6] Portland cement-based and pozzolanic-based (lime-silica) stabilization systems which may also be supplemented with other additives such as bentonite clays, silicates, phosphate, thiosulfates, carbonated, sulfide and other liquid or solid proprietary chemicals.
[7] Earthmoving equipment, excavator, front end loaders. Equipment operators will periodically inspect the waste for uniformity of color, consistency and homogeneity, taking special care to ensure that waste in the corners of the box are adequately treated.
[8] Cement, CKD, Fly ash, bentonite/clays, silicates, aluminates, and proprietary chemicals among others. Waster will be added in combination with treatment additives as needed to activate the pozzolanic properties of the reagents.
[9] Excavator
[10] "Because of the mixing, it is reasonable to approach the pile as a mass with no vertical or horizontal stratification.
[11] In CY 2013, ___ tested 640 of 762 batches, with a LDR failure (re-treatment rate) of 10.9%.
[12] During the inspection 10 put piles were sampled. 1 sample from each of five put piles was taken and 2 samples from the other five were taken for a total of 15 samples. Two samples from one pile both failed for Lead.
[13] This information was obtained from the WAP.
[14] In CY 2013, ___ tested 808 of the 3064 batches of hazardous waste treated.

Tier Testing

The first 3 loads are tested for LDR compliance with a single grab sample, if all 3 pass, the frequency changes to 1 in 3. After 4 loads pass, then frequency is changed to 1 in 5. If 6 or more loads pass, then frequency changed to 1 in 10 or 7 out of 26 samples tested.

If a load fails at any time, the process is re-set to the initial 3 load verification.

XXX
XXX
XXXXX
XXXXX
XXXXXXXXXX

X indicates a batch meeting LDR

Appendix 4 - Sampling Method and Frequency of Analysis for Stabilized Hazardous Wastes as Reported in Waste Analysis Plans (WAPs) for Commercial Treatment, Storage and/or Disposal Facilities

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
1		X[15]	X[16]	X[17]					X	
2		X[18]					X[19]	Random	X	
3					X			Representative, random grab sample strategy (grid pattern) for bulk treatment	X	
		X			X			Representative selected sample for containerized treatment	X	
		X			X			Initial random grab and once per calendar month for continuous treatment[20]		Once per calendar month
4				X	X			Representative random grab sample (grid pattern)	X	
				X	X			For certain batches alternative sampling strategy, initial random grab, only first batch every calendar month (grid pattern)[21]		For certain batches, first batch every calendar month
5		X[22]	X[23]	X		X[24]				Current and Periodic As needed
6		X							X	
7		X[25]	X[26]	X				Representative sample; Minimum of 4 locations spaced evenly apart, composited 80/90/100 rule[27]	X	

[15] Ferrous sulfate, lime, kiln dust, Portland cement, Fly ash, "diaper dust" (absorbent polymer) or paper pulp.
[16] Backhoes and shovels
[17] 40 cubic yard roll-off dumpsters
[18] Portland cement or other and added water.
[19] Minimum is 2 random grab samples per 25 cubic yards; failure of any grab warrants additional treatment and a second round of testing.
[20] Contaminated soil from same site, wastewater treatment filtercake from same generator, stormwater residues
[21] Sand blast grit, contaminated soils from same site, and wwt filtercake from same generator.
[22] Portland cement, CKD and/or other stabilization reagents; cement or pozzolanic material
[23] A post treatment evaluation occurs to determine if the waste is well-mixed.
[24] For a large container, more than one grab sample may be collected. None of the samples may exceed the applicable LDR standard.
[25] Cements, CKD, flyash, bentonite/clays, silicates, aluminates, and proprietary chemicals among others; water will be added in combination with treatment additives as needed to activate the pozzolanic properties of the reagents.
[26] Backhoe, excavator, mixing blades
[27] If the LDR results are within 80% or 90% of the treatment standard then that batch is subject to the 80/90/100 rule. A waste attains the treatment standard if one sample is less than or equal to 80% of standard, a minimum of two samples must be greater than 80% but less than 90% of standard, three samples required if one of results exceed 90% of the criterial.

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
8			X[28]					Representative sample or a repetitive sample (composite sample),	X	
9								Representative sample for metal microencapsulation treatment	X	
10		X[29]	X[30]	X				Six grab samples from waste pile or transport vehicle composited into one sample	X	
11								Grab sampling to collect representative sample	X[31]	First batch tested, annually thereafter
12					X			For single batch treatment operations		
								For multiple treatment batches of same waste stream from no less than 10% of the total number of containers, composite the random grab samples		
13		X			X					After initial successful batch stabilization, shipments of the same waste in bulk form will be tested as follows: 1-4 shipments per year, test one sample; 5-12 shipments test 2 samples; 13-24 shipments test 3 samples and >24 shipments test 4 samples.
		X[32]			X				For drums and containers each load is sampled and tested	
14										Treatment performance verification will be reviewed and approved by the facility management prior to land disposal. This

[28] Mixed to uniform appearance

[29] Lime, kiln and cement dusts or similar reagents. Water may be added to provide a better reaction matrix, but not in volumes which result in free liquids.

[30] Waste and reagent will be mixed to create a uniform, homogenous mixture.

[31] For consolidated wastes and wastes where reagents are not within 95% of selected mix ratio every batch or load is tested.

[32] E.g., Fly ash, cement dust, lime

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
										will be conducted as needed
15	WAP states that solidification occurs at the facility, however no additional information is provided.									
16								Facility personnel will randomly sample and analyze treated waste		
17		X	X[33]					Repetitive sampling or representative sampling by collecting several random samples (composite sample)	X	
18				X[34]			X[35]		X	
19								One grab sample from center of each pf the 4 portions, 4 grabs are then composited into one sample per truckload.		Quarterly
20		[36]			X[37]					The first load and annually thereafter (plus or minus one month), or whenever generator's process or wastestream changes.[38]
21		X			X[39]			Random grab	X	
22		X[40]	X[41]	X	X[42]				X	
23		X[43]								Post treatment analyses are performed, as necessary, to ensure restricted wastes meet applicable treatment standards.

[33] After solids processing batches from the pit mixing tank are mixed to a uniform appearance, via hydraulic excavator/backhoe bucket, the bucket scoops a sample for the operator to secure a sample

[34] In containers, tanks or temporary piles inside the containment building.

[35] Minimum of two grab samples of every treatment batch (typically one from the first mixer load and one from the last mixer load of each day.)

[36] Wastes will not be managed that contain organic constituents above LDR treatment standards, therefore stabilization verification sampling and analysis will not be conducted for organic constituents.

[37] State that they do a "grab and hold" interpret that to mean a grab sample

[38] For this facility there is a Wastestream confirmation sampling and analysis frequency, if waste exceeds a tonnage of greater that 2500 TPY, then sampling frequency changes from annually to monthly, If the tonnage is between 1000-2500 TPY at 250, 1000, and 1750 tons.

[39] Random grab

[40] Lime kiln flue dust, cement kiln flue dust, lime and fly ash, ferrous sulfate

[41] Tanks, pugmill

[42] Random grab, grid pattern

[43] Stabilization is the treatment of appropriate waste streams by use of pozzolonic materials to reduce the leachability of organic, inorganic or metals of concern.

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
										Filter cake sludges from treatment of listed HW are analyzed on a periodic (i.e., quarterly) basis.
24									X	
25		X[44]		X	X			Random single grab	X[45]	
26		X								Periodic basis, quarterly, as necessary
27								Representative[46]		At least annually
28		X[47]	X[48]	X[49]	X			Grab and hold testing		Periodic
29			X						X	
30								Repetitive sampling (composite sample)	X[50]	
31		X[51]		X				Representative and composite sampling		As needed to confirm successful treatment.
31a	Sampling was revised in 12/19/2016 WAP but not finalized, the new language is reflected here	X		X			X [52]		X[53]	
32						X				As needed, as necessary to ensure that the process continues to be effective.
33		WAP says treatment occurs however no LDR compliance information provided								
34		WAP states that this facility is a commercial TSD that treats listed and characteristic waste however no information on LDR provided								
35		X[54]		X[55]						Approximately 10-20% of the treated batches are tested to confirm

[44] CKD, lime and/or other reagents

[45] All treatments are verified through actual post treatment analysis of treatment residue, prior to disposal of the waste.

[46] A representative sample of the solid residue from the dewatering is evaluated at least annually to allow for disposal or recovery at an approved off-site facility.

[47] Portland cement-based and pozzolanic-based (lime-silica cement) stabilization systems which may also be supplemented with other additives such as bentonite clays, silicates, phosphates, thiosulfates, carbonates, sulfide, and other liquid or solid proprietary chemicals.

[48] Earthmoving equipment, excavator, front end loaders; Equipment operators will periodically inspect the waste for uniformity of color, consistency and homogeneity, taking special care to ensure that waste in the corners of the box are adequately treated.

[49] Waste is removed from mixing box and placed in a roll-off box, a dump truck or a dump trailer.

[50] On a routine basis, ___ submits a certification for each load of treated material disposed of in a non-hazardous waste landfill to the Director of the Ohio EPA verifying that each load has met LDRs. Final treatment certification/solids processing. Every batch is sampled as it is discharged from the blender to the dump trailer.

[51] Lime, cement kiln dust, etc.

[52] Three grab samples taken ALL must meet LDRs.

[53] For wastes approved by the WDNR, a reduced sampling and analysis frequency may be utilized. For these wastes, only the first and last boxes of treated wastes from the treatment run will be sampled and analyzed in order to ensure that the process continues to be effective in meeting the treatment standards.

[54] Fly ash, Portland cement, cement kiln dust, lime, gypsum

[55] Treated batches of wastes are assumed to meet the applicable treatment standard and will be located in the landfill cells. If post treatment analyses determines that a treated batch does not meet the standard, the batch will be retrieved for retreatment…Retrieved materials may be staged prior to retreatment for period not to exceed 72 hours on the truck parking pad.

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
										adequate treatment and/or to refine the appropriate recipes. The treatment process is verified periodically, typically at least annually
36		X								
37					X				X[56]	
38										First batch and at least once per year thereafter[57]
39				X						Periodic basis. First two batches and at least once annually. May be increased if waste shows variable characteristics
40							X			Ten grabs from stabilized filtercake or ash, annually thereafter
41					X					Initial load, thereafter minimum frequency of once per quarter
42	(No information in WAP)									
43					X			Representative grab sample		10% of campaign. If three successive campaigns meet LDRs, then one in 20 campaigns is tested.
44				X[58] Put piles	X					One sample from first three treatment runs tested. One sample from 10% of treatment runs until 15 treatment runs have been tested. Then, one sample from 5% of treatment runs. Treatment run is defined as all residues of one waste stream that are treated using the same treatment unit during one calendar day.

[56] One sample will be collected and analyzed from each batch of stabilized waste. A batch is defined as one receiving pan of waste, which is approximately 100 yd3.
[57] Infrequent shipments test every batch.
[58] While awaiting the first round of sampling results, shipments shall not be treated or disposed. However, for the annual or semi-annual confirmation sampling of bulk waste, the corresponding shipment of waste may be kept in the landfill cell provided that the waste is prevented from commingling with other wastes.

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
45			X "Because of the mixing, it is reasonable to approach the pile as a mass with no vertical or horizontal stratification"	X Put pile	X					Option 1: Each treated batch; or Option 2:a Tier 1 – Test batches 1-10 Tier 2 – Test batch 10, batches 11-14 no testing. Test batch 14; batches 16-19 no testing Tier 3 – Test batch 20, batches 21-29 no testing. Test batch 30; batches 31-39 no testing. Test batch 40, batches 41-49 no testing; or Option 3: Total analysis too low, no TCLP testing.
46	(no information provided)									
47				X[59]	X[60]			Single Random Grab sample	X[61]	
48		X			X					Test first three batches, if pass proceed to annual testing[62]
49		X	X[63]	X	X[64]			One random grab		For similar wastes with similar treatment a minimum of 10% of treated loads will be sampled.
50	(No detailed information provided)									
51	(No trt to LDRs)									
52	(No information, LDR treatment done off-site)									

[59] Once treated, solid wastes will be placed in roll-off bins and placed in the treated waste are or Landfill. Once treatment is verified, the treated wastes will be moved to the landfill for disposal.

[60] Random grab

[61] After a waste has been treated by the s/s process at the facility, one random grab sample will be taken from each batch of treated wastes.

[62] Every batch or load is tested if waste streams are combined for stabilization

[63] Pugmill, auger shredder, conveyors. Waste should be well mixed.

[64] Random grab

No	Facility (*names redacted*)	Treatment and Storage			Sampling				Frequency of Testing	
		Reagents Identified	Mixing Method/ Mixing Time/Homogenous Mix Reported	How Waste is Stored Post Treatment	Single grab	Grab sampling	Multiple Grabs	Other	Every batch/load/roll-off tested	Other Type of Testing Frequency (Tiered, Annual, Quarterly)
53		X		X (in storage or disposal units)		X[65]				Every batch unless same source routinely received then first batch tested, Annual testing, thereafter.. However, for wastes exhibiting significant variability in characteristics, sampling frequency may be increased to every batch.
54	(Note: WAP references definition of stabilization in 268.42 to reduce the leachability of the metal or organic)	X	X[66]			X[67]		Composite samples		First two batches, and at least once a year thereafter Post treatment analyses are performed as necessary
55				X[68]				3 grabs to make composite		First three loads for each profile, quarterly thereafter
56										
57										
	Number of Facilities	25/57 (44%)	12/57 (21%)	20/57 (35%)	21/57 (37%)	4/57 (7%)	3/57 (5%)	14/57 (25%)	23/57 (40%)	28/57 (49%)

[65]Testing may be on a single grab, WAP states that "When verifying that waste has been treated to meet LDR treatment standards, compliance with concentration standard is based on grab sampling. When there is any uncertainty in achievement of treatment standards, the treated waste is re-sampled

[66] Excavator

[67] In one section of the WAP grab sampling is identified, in another section composite is identified.

[68] Post treatment analysis is performed in storage or treatment unit. There shall be no interim storage in a landfill unit unless this Permit is modified to do so.